COMPONENTS:	EVALUATOR:
(1) Tellurium; Te; [13494-80-9] (2) Mercury; Hg; [7439-97-6]	C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION:

The solubility of tellurium in mercury is very low at room temperature. Kozin (1) first predicted a solubility of 2.3×10^{-4} at % at 298 K; he later (2) corrected this estimate to 5×10^{-3} at %. Gladyshev and Kovaleva (3), without giving details of their polarographic method, reported that the solubility is of the order of 10^{-4} at % at room temperature; these authors subsequently reported a solubility of 1.4×10^{-3} at % (34), but this value appears too high. Pajaczkowska and Dziuba (4) determined the solubility of tellurium in the temperature range of 487-943 K, and these authors showed that their data were in good agreement with equations based on ideal solution theory. Part of the results from (4) were subsequently confirmed by Herning (35). Extrapolation of the data of (4) and (35) leads to a solubility of 2×20^{-4} at % at 298 K.

The first report of a phase diagram for the Hg-Te system was that of Pellini and Aureggi (5) who determined the liquidus line in the Te-rich region. These authors found an eutectic at 87.8 at %. Strauss and coworkers (6-9) determined the complete liquidus line by thermoanalysis and found the eutectic at 83.5 at % Te. Levitskaya and coworkers (10), reported the eutectic at an appreciably higher concentration of 91.2 at % while Williams found it at 83.3 at % Te (11). The calculated eutectic points in the Hg and Te-rich regions are 2×10^{-5} at % and 85.4 at % of Te at 234.3 K and 686.7 K, respectively (12). The partial phase diagrams of refs. (4) and (5) are in general agreement with that of Strauss and coworkers. The phase diagram shows only a single congruently melting compound, HgTe. But, the melting point of HgTe has been reported at various values between 873 and 960 K (6-10, 13-31); the wide range of melting points is due to errors arising from the high volatility of HgTe. The most reliable melting point appears to be 943 K (6,7,19,26-28). Other melting points ranging from 929 to 960 K have been reported (29-31), but the experimental conditions were not defined. The low value of 873 K (14) is rejected. It has been demonstrated (32,33) that the melting point of HgTe has a significant dependence on the vapor pressure over the compound; it was observed that the melting point was 888 K at 12.2 kbar, and, as shown in Fig. 2, there was a linear dependence of the melting point on the pressure (33). The measurements of Steininger (25) and of Brebrick and Strauss (7) show that the melting point is at 941 and 943 K at 13.6 and 12.6 kbar, respectively. Slightly different pressure dependence of the phase relations is presented by Omelchenko and Soshnikov (27).

Delves and Lewis (19,21) showed that the Hg-Te system consists of a two-liquid region on the Te-rich side, and Levitskaya and coworkers (10) confirmed this observation at 52.5-55.7 at % Te. The monotectic temperature was found to be 937 ± 2 K by the former authors. The parameters of the immiscibility region and the solubility at low Te contents need further investigations.

The tentative values of the Te solubility in Hg:

T/K	Soly/at %	Reference
500	0.16	[4,35]
600	1.5[a]	[4,35]
684	2.4[a]	[4,8,35]
700	5.5[a]	[4,8,35]
800	15[a]	[4,8]
900	32	[4,8]

Completely miscible above 943 K.

[a] Interpolated from data of cited references.

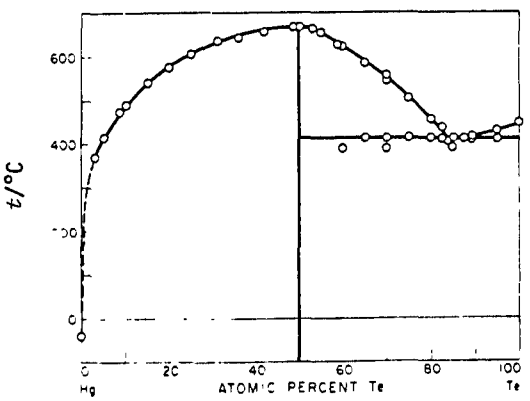

Fig. 1. Phase diagram of the Te-Hg system (8).

COMPONENTS:	EVALUATOR:
(1) Tellurium; Te; [13494-80-9] (2) Mercury; Hg; [7439-97-6]	C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION:

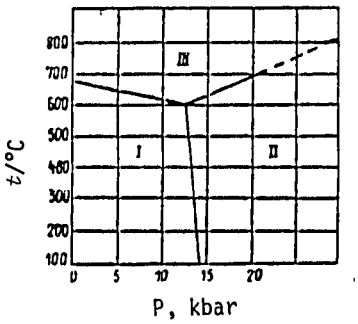

Fig. 2. Dependence of melting point of HgTe on pressure (33).

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COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Tellurium; Te; [13494-80-9] (2) Mercury; Hg; [7439-97-6]	Ray, B.; Spencer, P.M.S. *Phys. Stat. Sol.* 1967, *22*, 371-372.
VARIABLES: Temperature	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The liquidus line for the CdTe-HgTe system was determined. The melting point of HgTe, read from the liquidus, was 666°C. A value of 665 ± 2°C was subsequently reported by the same authors (1).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The powdered samples were sealed in quartz ampules filled with inert gas under pressure of several atmospheres. The melting point was determined by differential thermal analysis.

SOURCE AND PURITY OF MATERIALS:

High purity HgTe was synthesized from Te (99.9995% pure) from Canadian Copper Refiners, Ltd. and triply distilled Hg.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: precision ± 3 K.

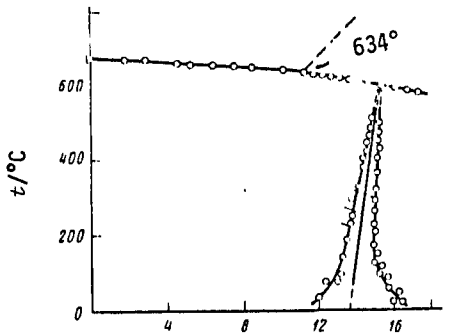
REFERENCES:

1. Spencer, P.M.; Ray, B. *Brit. J. Appl. Phys., Ser. 2* 1968, *1*, 299.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Tellurium; Te; [13494-80-9] (2) Mercury; Hg; [7439-97-6]	Omelchenko, A.V.; Soshnikov, V.I. *Izv. Akad. Nauk SSR, Neorg. Mater.* 1982, *18*, 685-6. English translation: *Inorg. Mater.* 1982, *18*, 582-84.
VARIABLES: Pressure	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The pressure dependence of the melting point of HgTe is shown in the figure. The melting line shows two linear segments which correspond to the melting points of the I and II phases. The inflection point of the line is at 634°C and 11.11 x 10^8 Pa.



AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Milled crystals of HgTe were pressed into specimens. The pressure was applied to the specimens in an apparatus of piston-cylinder type; argon was used to transmit pressure at temperatures above 550°C and benzene was used at lower temperatures. Phase transition of HgTe in the solid state was determined by dilatometric method, and melting temperatures were determined by thermal analysis with the use of a Chromel-Alumel thermocouple. Pressure was determined by a manganin resistance manometer.

SOURCE AND PURITY OF MATERIALS:

n-type HgTe with n_e = 3 x 10^{17} cm^{-3}.

ESTIMATED ERROR:

Pressure: accuracy ± 1.5 x 10^7 Pa.

Temp: accuracy ± 2 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Tellurium; Te; [13494-80-9] (2) Mercury; Hg; [7439-97-6]	1. Delves, R.T.; Lewis, B. *J. Phys. Chem. Solids* 1963, *24*, 549-556. 2. Delves, R.T. *Brit. J. Appl. Phys.* 1965, *16*, 343-351.
VARIABLES:	**PREPARED BY:**
Temperature	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The melting point of HgTe was determined to be 670 ± 1°C and the monotectic was at 664 ± 2°C. The maximum on the liquidus was observed to be approximately 2.5 to 4 at % on the Te-rich side of HgTe; this may have been caused by a deficiency of 2 at % Hg in the actual composition near HgTe. The eutectic on the Te-rich side was found at 409 ± 2°C. The two-liquids region was found to be between $HgTe_{1.12}$ and $HgTe_{1.25}$.

The HgTe-MnTe system also was investigated.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

HgTe was prepared by melting mercury and tellurium in an evacuated silica tube. The tube was initially heated to 450°C then slowly heated to 700°C while the tube was continuously rocked to ensure complete mixing of the elements. The tube was then quenched to 550°C, and slowly cooled. Differential thermal analysis of the powdered samples of HgTe was performed. For the determination of the two-liquids region, appropriate amounts of the elements were melted in a silica tube then the melts were directionally frozen in a gradient furnace.

SOURCE AND PURITY OF MATERIALS:

Tellurium was melted in an atmosphere of hydrogen and zone refined. This resulted in a purity of at least 99.99%; Bi, Sb, and Se were the major impurities.

Mercury was purified by triple distillation and resulted in a purity of 99.999%.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: precision ± 2 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Tellurium; Te; [13494-80-9] (2) Mercury; Hg; [7439-97-6]	Pellini, G.; Aureggi, C. *Gazz. Chim. Ital.* 1910, *40* (2), 42-9.
VARIABLES: Temperature: 408-548°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The data were presented graphically; the following data were read off the liquidus curve by the compilers:

t/°C	Soly/at %
431	95
422	90
408.5	87.8
464	80
493	75
535	70
548	66.6

An eutectic point for mercury-rich amalgams was also observed but the information is not quantitatively exact. The same results are also reported in (1).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amalgams were prepared by heating the elements in hydrogen atmosphere saturated with mercury vapors. Thermal analyses were made with the use of a Pt-PtRh thermocouple.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Pellini, G; Aureggi, C. *Atti Accad. Nazl. Lincei* 1909, *18* (2), 211.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Tellurium; Te; [13494-80-9] (2) Mercury; Hg; [7439-97-6]	Brebrick, R.F.; Strauss, A.J. *J. Phys. Chem. Solids* 1965, *26*, 989-1002.
VARIABLES: Temperature; Pressure	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Liquidus temperatures of tellurium amalgams determined in this work[a] and values abstracted by the compilers from the graphical data in refs. (1) and (2). P is equilibrium pressure of mercury:

T/K	P/atm	Soly/at %	Ref.	T/K	P/atm	Soly/at %	Ref.
643	-	3.1	1	927	-	55.0	1,2
689	-	5.4	1	901	4.4	58.7	a,1,2
748	-	8.8	1	898	-	60.0	1,2
764	-	10.3	1	859	-	65.0	1,2
815	-	15.3	1	828	-	70.0	1,2
849	-	20.3	1	816	-	70.0	1
881	-	25.0	1	776	-	75.0	1,2
911	19	31.1	a,1	729	-	80.3	1,2
918	19	36.1	a,1	708	-	82.7	1,2
932	19	41.8	a,1	687	-	85.3	1
943	16	48.5	a,1	688	-	87.5	1,2
943	-	50.2	1,2	690	-	89.2	1,2
939	9	52.8	a,1,2	706	-	95.0	1,2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Thermal analysis was used in refs. (1) and (2) to determine the liquidus. In this work the optical densities of the vapor in equilibrium with liquid and solid amalgams were measured between 2000 and 6000 Å. Samples were sealed in evacuated thick-wall silica optical cells with parallel flat windows and a sidearm. The latter served as the cold spot reservoir for the amalgam. Zero optical density was found with the condensed phases at room temperature. For each run, the optical cell was heated to its measurement temperature and maintained there for a minimum of one hour before the spectral measurements were made.

SOURCE AND PURITY OF MATERIALS:

Zone-refined tellurium of 99.999% purity from Ohio Semiconductors, Inc., and spectrographic grade mercury from Johnson Matthey Co.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: precision ± 2 K.

REFERENCES:

1. Strauss, A.J.; as quoted by T. C. Harman, *Physics and Chemistry of II-VI Compounds*. M. Aven, J.S. Prenner, eds. North-Holland. Amsterdam. 1967, 774.
2. Tung, T.; Golonka, L.; Brebrick, R.F. *J. Electrochem. Soc.* 1981, *128*, 1601.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Tellurium; Te; [13494-80-9] (2) Mercury; Hg; [7439-97-6]	Pajaczkowska, A.; Dziuba, E.Z. *J. Cryst. Growth* 1971, *11*, 21-4.
VARIABLES:	**PREPARED BY:**
Temperature: 487-940 K	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubilities of tellurium in mercury were presented in graphical form. The data points were read from the curve by the compilers.

T/K	Soly/at %
487	0.11
571	0.75
578	1.0
602	1.7
621	2.0
658	3.1
667	3.3
680	4.8
694	5.5
775	11.7
940	50.0

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Appropriate amounts of tellurium and mercury were placed in quartz tubes which were then evacuated and sealed. The thermal analysis of the samples was performed by measuring the temperature with a constantan-chrome nickel thermocouple. The dissolution and crystallization processes were repeated several times for every concentration, and melting temperatures were taken as the experimental points for the liquidus line.

SOURCE AND PURITY OF MATERIALS:

The metals were of spectroscopic purity.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: precision ± 5%, with reference to measured temperature in °C.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Tellurium; Te; [13494-80-9] (2) Mercury; Hg; [7439-97-6]	Steininger, J. *J. Electron. Mater.* 1976, *5*, 299-320.
VARIABLES: Temperature: 929-941 K	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The melting temperatures of HgTe and $Hg_{0.6}Te_{0.4}$ were determined to be 941 and 929 K at Hg vapor pressures of 13.6 and 19.2 atm, respectively.

CdTe-HgTe system was the main purpose of this investigation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Appropriate proportions of the elements, with slight excess of mercury, were placed in a quartz ampule reflux tube. The ampule was placed in a high pressure furnace with a negative temperature gradient along the reflux tube. After evacuation and flushing, the furnace was pressurized with argon and rapidly heated to above the liquidus temperature. Cooling curves under different pressures were recorded with the use of a Chromel-Alumel thermocouple.

SOURCE AND PURITY OF MATERIALS:

99.9999% pure elements were used. Argon purity was 99.999%.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: precision ± 1 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Tellurium; Te; [13494-80-9] (2) Mercury; Hg; [7439-97-6]	Szofran, F.R.; Lehoczky, S.L. *J. Electron. Mater.* 1981, *10*, 1131-50.
VARIABLES: One temperature: 669°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The melting temperature of HgTe is 699.5°C.

The pseudobinary CdTe-HgTe phase diagram was also investigated.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Fused silica ampules were etched in HF solution and annealed at 1423 K in vacuum. The Te bars were etched in Br_2 and rinsed repeatedly in methanol. The ampules were loaded with Hg and Te. They were evacuated and backfilled with He several times before the final evacuation and sealing. The differential thermal analysis curves were recorded, with the use of a calibrated Chromel-Alumel thermocouple, at various rates of cooling and heating.

SOURCE AND PURITY OF MATERIALS:

99.9999% pure Te and 99.99999% pure Hg were used.

ESTIMATED ERROR:

Composition: precision better than $\pm$ 0.1%.

Temp: precision $\pm$ 1.7 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Tellurium; Te; [13494-80-9] (2) Mercury; Hg; [7439-97-6]	Gladyshev, V.P.; Kovaleva, S.V.; Sarieva, L.S. *Zh. Anal. Khim.* 1982, *37*, 1762-6.
VARIABLES:	**PREPARED BY:**
One temperature: 293 K	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubility of tellurium in mercury at 293 K was reported as 9×10^{-4} mass %. The solubility in atomic % calculated by the compilers is 1.4×10^{-3} at %.

It seems that the result is overstated due to short drop times of the electrode, and the equilibrium between the saturated amalgam and the solid phase is not reached.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Te(IV) was reduced on the dropping mercury electrode by direct and alternating current polarography. The background electrolyte contained 1 mol dm^{-3} of NaOH. The results were analyzed on a plot of peak current vs. logarithm of concentration of Te(IV). A bend on the curve corresponds to the saturation concentration of Te in Hg since crystallization of HgTe causes an inflection in the recorded curve.

SOURCE AND PURITY OF MATERIALS:

Very pure TeO_2 and Hg of purity "R-O" were used.

ESTIMATED ERROR:

Soly: $\pm$ 10%.

Temp.: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Tellurium; Te; [13494-80-9] (2) Mercury; Hg; [7439-97-6]	Herning, P.E. *J. Electron Mater.* 1984, *13*, 1-14.
VARIABLES: Temperature: 189-431°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of Te in Hg at several temperatures were read off a curve by the compilers.

t/°C	Soly/at %
189	0.1
250	0.4
298	1.0
323	1.5
343	2.0
376	3.0
431	6.0

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Assuming that the technique of the solubility determination was the same as for CdTe in Hg, described in this paper, the procedure was as follows:
A carefully weighed piece of Te was lowered into Hg on a graphite paddle assembly. The melt was stirred for more than 4 hours. After saturating the Hg in this manner, the Te was weighed again; the difference was recorded. Completeness of the saturation was checked by observing the melt surface while slowly lowering the temperature. The amalgams supersaturate only very slightly, probably less than 0.1 K.

SOURCE AND PURITY OF MATERIALS:

Hg was 99.99999% pure; Te purity not specified.

ESTIMATED ERROR:

Temp: accuracy ± 5 K.

Soly: nothing specified, error may be as high as ± 10% (compilers).

REFERENCES: